4.16 Shoreline Erosion

4.16.1 Introduction

Resource Issues

- Rate of erosion of reservoir and tailwater shorelines

Soil erosion, whether from upstream land use practices or from the cutting away of stream and reservoir shorelines, can cause adverse environmental impacts. Sediments from eroded soils can alter water chemistry and aquatic habitats, restrict navigation, and reduce water storage capability. Erosive forces can cause stream and reservoir banks to recede, resulting in loss of land and vegetation that provides important canopy cover for habitat. Sediments and nutrients, particularly nitrogen and phosphorus, from eroded soils are the cause of water quality impairment of more miles of rivers and streams in the United States than any other pollutants (USEPA 1992).

Natural erosion is a process driven by raindrop impact forces, streamflow shearing forces, and wave energy that dislodges and moves sediments from highlands through waterways to the oceans. Human activities have and will continue to accelerate the natural process. A portion of the erosion and sedimentation affecting the waterways in the TVA system is a result of land use activities in the backlands that are within the watershed but outside the control of TVA, such as soil disturbances associated with construction, agriculture, and forestry. Some erosion and associated sedimentation also occurs in the tailwater streambanks and the reservoir shorelines due to the presence and operation of TVA facilities for power generation, navigation, flood control, and recreational use (boating). These latter causes of erosion are the subject of this section. Sediment contamination of TVA waterways, produced either through reservoir operations or from activities on land within the watershed, is discussed in Section 4.4, Water Quality.

The primary issue for this resource area is the potential changes (increase) in the rate of erosion of reservoir and tailwater shorelines.

To help focus the definition of the affected environment, the erosion analysis used seven representative reservoirs and tailwaters of THE TVA system (Table 4.16-01). Considerations used to select the reservoirs and tailwaters included representation of the various physiographic regions in THE TVA study area, representation of both mainstem and tributary reservoirs, and the amount of available data.

Table 4.16-01 Representative Reservoirs Used in the Erosion Analysis

Reservoir	Physiographic Region	Reservoir Type
Chatuge	Blue Ridge	Tributary
Douglas	Valley and Ridge	Tributary
Fort Loudoun	Valley and Ridge	Mainstem
Nickajack	Appalachian Plateaus	Mainstem
Tims Ford	Interior Low Plateaus	Tributary
Normandy	Interior Low Plateaus	Tributary
Pickwick	Coastal Plain	Mainstem

4.16.2 Regulatory Programs and TVA Management Activities

Regulatory Programs

Section 26A of the TVA Act provides TVA with permit authority for structures along the shoreline. This regulation allows TVA to require applicants to incorporate erosion control measures into the design and construction of docks and other alterations fronting waterfront residential property.

TVA Management Activities

Hydro-Modernization Program. TVA is rehabilitating and modernizing the hydro turbine units at various dams. The HMOD Program seeks to improve operating efficiency and provide additional peak generating capacity while maintaining safe and reliable peak power generation. When the modernization of the units may potentially increase peak flows and change flow–duration relationships, TVA prepares an investigation regarding the potential effects on erosion in the tailwater. The investigations are incorporated into Environmental Assessments under NEPA where appropriate. To date, TVA has prepared assessments of potential effects on erosion potential related to HMOD proposals for nine dams and will continue to prepare these assessments as units are scheduled for HMOD consideration.

Shoreline Treatment Program. TVA has been conducting a widespread, intensive effort to treat critical erosion sites. Shorelines for the entire TVA reservoir system have been surveyed to identify and prioritize those that are in need of stabilization. Treatment techniques are focused on natural methods of bioengineering (vegetative plantings) where appropriate, which provide increased benefits to aquatic habitat, water quality, and aesthetics. More intensive treatment techniques, such as riprap, a combination of riprap and bioengineering, gabion walls, or live crib walls are used if needed. TVA typically applies stabilization treatments to approximately 20 critically eroded sites each year (TVA 1998). TVA can treat shorelines only on TVA-owned and

managed lands; however, TVA encourages private landowners to implement treatments and provides educational materials.

4.16.3 Reservoir Shoreline Erosion Conditions

Existing Conditions

TVA has conducted an extensive analysis of the shoreline conditions of each reservoir in its system to prioritize erosion sites for possible future treatment. TVA maintains the Automated Land Information System (ALIS) Shoreline Conditions Database (TVA 2002), a geographic information system (GIS) for storing and graphically displaying shoreline conditions. The ALIS data cover virtually all of the shorelines in THE TVA reservoir system; however, the data describes the shoreline conditions only at summer pool elevations. No data are currently available about the shoreline status at winter pool elevations or at intermediate elevations between summer pool and winter pool. Conditions used to characterize most reservoirs included riparian zone value, percent canopy, percent erosion, percent gravel, percent cover, percent habitat value, and slope. For some reservoirs, only vegetation conditions and erosion conditions have been recorded. Scores for these metrics were combined to provide a ranking of the shoreline condition of “good,” “fair,” or “poor.” Table 4.16-02 shows the breakdown of shoreline classifications for each of the representative reservoirs in terms of miles of shoreline and percent of the total reservoir in each ranking classification. Figure 4.16-01 shows the percentage of each representative reservoir in the ranking classification.

Most of the shorelines for the seven representative reservoirs are in good or fair condition. Approximately half of the reservoir shorelines are classified as good; of the remaining half, almost all are classified as fair. Only between 1 and 5 percent of the representative reservoirs are classified as poor. Tims Ford is an exception, with 7.9 percent in poor condition and only 18.9 percent in good condition; 73.2 percent of Tims Ford is in fair condition. Although the percentage of shoreline classified as poor is low compared to the percentage in fair and good classifications, the overall miles of shoreline in poor condition are substantial due to the vast size of the reservoir system. For example, although only 4.8 percent of the Fort Loudoun Reservoir is classified as poor, this equates to 16.2 miles of shoreline.

Future Trends

Without a change in reservoir operations, erosion in the reservoirs is anticipated to continue through the 2030 study period. Factors such as the 16-percent projected increase in recreational boating (see Section 4.24, Recreation) and the associated boat waves would likely accelerate the erosion of shorelines. The application of treatments and best management practices (BMPs) by TVA and other shoreline landowners would partially reduce erosion effects.

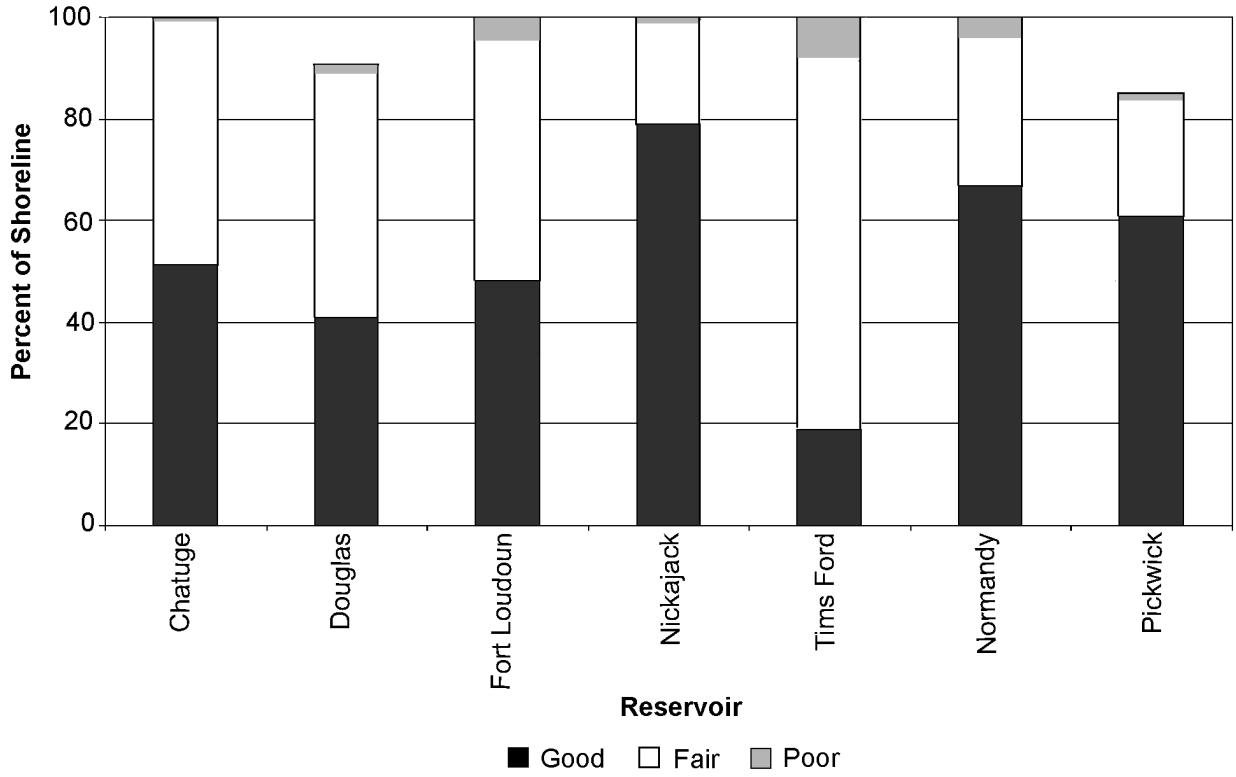
Table 4.16-02 Reservoir Shoreline Erosion Conditions from TVA Automated Land Information System (ALIS) Data

Erosion Conditions	Reservoir						
	Chatuge	Douglas	Fort Loudoun	Nickajack	Tims Ford	Normandy	Pickwick
Total shoreline miles	128.1	512.7	335.9	137.0	259.0	75.1	491.3
Miles shoreline ranking poor	1.2	10.1	16.2	2.1	20.4	3.0	6.1
Percent shoreline ranking poor	0.9	2.0	4.8	1.5	7.9	4.0	1.2
Miles shoreline ranking fair	61.1	244.6	157.8	26.8	189.7	21.8	113.7
Percent shoreline ranking fair	47.7	47.7	47.0	19.5	73.2	29.1	23.1
Miles shoreline ranking good	65.9	209.7	162.0	108.5	48.9	50.3	298.3
Percent shoreline ranking good	51.4	40.9	48.2	79.0	18.9	66.9	60.7

Note:

Conditions used to characterize most reservoirs included riparian zone value, percent canopy, percent erosion, percent gravel, percent cover, percent habitat value, and slope. For some reservoirs, only vegetation conditions and erosion conditions have been recorded. Scores for these metrics were combined to provide a ranking of the shoreline condition of “good,” “fair,” or “poor.”

Source: Compiled by Normandeau Associates 2002.



Note: Because no ratings are available for 48 miles at Douglas, 3.7 miles at Normandy, and 73.1 miles at Pickwick, less than 100 percent of the shoreline has been rated.
Source: TVA data 2003.

Figure 4.16-01 Reservoir Shoreline Erosion Rankings (Percent)

4.16.4 Tailwater Shoreline Erosion Conditions

Existing Conditions

Tailwaters include the waterbodies immediately downstream of dams. Tailwaters can be subdivided into tributary and mainstem tailwaters. Tributary tailwaters are riverine waterbodies, whereas mainstem tailwaters typically are the upstream section of the next downstream reservoir. Data for the conditions of the representative tailwaters were obtained from the erosion potential surveys conducted for HMOD reports and from a field survey program conducted in November 2002. The tailwater surveys generally considered:

- Bank stability at the toe and high-flow areas and evidence of existing erosion;
- Slope and height of the stream bank;
- Canopy cover—the percentage of tree or shrub cover along the bank; and,
- Riparian zone—the width of area adjacent to the bank containing woody vegetation.

Qualitative assessments were made of these characteristics for segments of the river that exhibited consistent properties (for those tailwaters studied for HMOD analysis) or at specific discrete locations along the tailwater (for those tailwaters surveyed by Normandeau Associates in November 2002). The data then were generalized to classify the condition of the entire tailwater. Table 4.16-03 summarizes the results of the surveys.

Table 4.16-03 Tailwater Shoreline Erosion Conditions

Tailwater	Bank Stability	Slope and Height of Bank	Canopy Cover	Riparian Zone
Mainstem Tailwaters				
Fort Loudoun	TBD	TBD	TBD	TBD
Nickajack	Fair to good	Varies from 1.5:1 to vertical, high	Good	Good
Pickwick	Poor	Typically 1:1 and high	Poor to fair	Poor to fair
Tributary Tailwaters				
Tims Ford	Poor to good	Typically 1:1 and low	Fair	Fair
Normandy	Fair to good	Typically 1:1 and low	Fair	Fair
Chatuge	Fair to good	Steep and high	Good	Good
Douglas	Fair to good	Steep and low	Good	Fair

Future Trends

Without a change in reservoir operations, erosion in the tailwaters is anticipated to continue s through the 2030 study period. Although recreational use is not thought to be a primary driver in erosion of tributary tailwaters (see Section 5.16), increased recreational boat traffic would likely accelerate the erosion of shorelines. The application of treatments and BMPs by TVA and other shoreline landowners would partially reduce erosion effects.